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Proceedings of the Maritimes Regional Advisory Process Stock Assessment Update of SPA 1,3,4,5 and 6 Scallop Stocks

8-9 December 2004
MicMac Amateur Aquatic Club
Dartmouth, Nova Scotia

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Réunion du Processus consultatif régional des provinces Maritimes Mise à jour des évaluations des stocks de pétoncle des APP 1,3,4,5 et 6

8-9 décembre 2004
MicMac Amateur Aquatic Club
Dartmouth (Nouvelle-Écosse)

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Foreword

The purpose of these proceedings is to archive the activities and discussions of the meeting, including research recommendations, uncertainties, and to provide a place to formally archive official minority opinions. As such, interpretations and opinions presented in this report may be factually incorrect or mis-leading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement had been reached.

Avant-propos

Le présent compte rendu fait état des activités et des discussions qui ont eu lieu à la réunion, notamment en ce qui concerne les recommandations de recherche et les incertitudes; il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s'est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s'il est clairement indiqué qu'elle l'est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

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ABSTRACT

These proceedings record discussions that were held during the Regional Advisory Process (RAP) meetings for the Stock Assessment Update of SPA 1,3,4,5 and 6 Scallop Stocks in the Maritimes Region on December 8-9, 2004. The scientific peer review of the Stock Assessment Update of SPA 1,3,4,5 and 6 Scallop Stocks was conducted. The discussions from this meeting are presented in this document.

RÉSUMÉ

Le présent compte rendu relate les discussions tenues pendant les réunions du Processus consultatif régional (PCR) portant sur la mise à jour des évaluations des stocks de pétoncle des APP 1,3,4,5 et 6 dans la Région des Maritimes, les 8 et 9 décembre 2004. Lors de ces réunions, on a procédé à un examen scientifique par les pairs de la mise à jour des évaluations des stocks de pétoncle des APP 1,3,4,5 et 6; les discussions auxquelles il a donné lieu sont présentées ici.

INTRODUCTION

The meetings were held at the Mic Mac Amateur Aquatic Club in Dartmouth, Nova Scotia . The Invitation letter and list of Invitees are in Appendix 1 and 2. The Chairman, René Lavoie, welcomed the participants (Appendix 3), reviewed the Remit for the meeting (Appendix 4), explained the procedure for the meeting, the specific role of scientific referees, industry representatives and observers, and reviewed the agenda (Appendix 5).

The Chairman explained that the objective of the meeting was to conduct a thorough peer review of the stock assessment updates presented by biologists-in-charge Steve Smith and Dale Roddick with input from representatives of the Province of Nova Scotia and from the industry. He also clarified that the RAP was NOT the place to discuss management considerations. This is the role of the Inshore Scallop Advisory Committee (ISAC)

SUMMARY OF PRESENTATIONS

Scallops in SPA 1

Overall landings in SPA 1 are above the long term median levels for all fleets.
Full Bay 674 t; Mid and Upper Bay 261 t

Survey:

The survey was moved from May-June to August-September due to increasing conflict with lobster gear. In recent years lobster gear has been encountered out to the middle of the bay, whereas it was formerly only encountered close in to shore.

Vessel problems caused a further delay to September-October, and shortening of the survey time. The survey did not cover as much of SPA 1 as it has the last few years, it covered 8-16 mile and Cape Spencer grounds, but not the areas further up the bay, especially the Upper Bay area.

In the 8-16 mile area off Digby survey numbers per tow are declining to the low levels seen in 1994-2000, before the latest recruitment pulse. In the Cape Spencer area the survey indicies are level. The year-class that will recruit in 2005 appears to be below average in both areas, but there are signs of an above average year-class concentrated along the Mid-Bay line which will recruit in 2006.

Commercial catch rates for both fleets declined in 2004, especially those for the Full Bay fleet in the 8-16 mile area. They are expected to decline further in the 8-16 mile area and drop slightly in the Cape Spencer area.

In the Upper Bay the short CPUE time series increased to a peak in 2002, then dropped slightly in 2003-2004. It is still above the median level of this short time series. With no survey estimates of recruits and pre-recruits we cannot predict the 2005 fishery.

The population model developed two years ago has been revised, and appears to have an improved ability to forecast the population size in the following year. The main difference between the results of the old and revised models is a lower estimated biomass during the peak periods. It appears that catchability may increase with biomass. This was supported by the fishermen at the meeting who stated that the catches are cleaner, with less rocks, during

periods of high abundance. The effect of this was that the old model overestimated abundance during the peaks. This resulted in quotas that were higher than the present model would indicate, and so the biomass was fished down sooner than anticipated.

Conclusions:

- Large 1998 year class off Digby has been fished down.
- Catch rates are level to declining.
- No sign of strong recruitment for 2005.
- For Cape Spencer & 8-16 mile areas an above average year-class should recruit in 2006.
- With a 2005 SPA 1B quota at level of current landings CPUE's will decline further

Will likely be more fishing by Full Bay fleet in SPA 1B in 2005

Scallops in SPA 1 (8–16 mile)

- Population model
  - Delay-difference model fit to catches, survey biomass, clappers and growth estimates from survey.
  - Decision rule for setting TACs set on basis of probability of population biomass decreasing below threshold level.
  - Model forecasts declining in reliability.
  - Analysis of relative selectivity by shell height data from survey suggest that catchability to survey gear has varied over time.
  - New model developed allowing for variable catchability. This improved forecasts but suggest that population biomass substantially less than previously estimated.
  - Given population now estimated to be smaller, decision rule based on maintaining population above threshold no longer applicable. New approach will need to be developed.

Scallops in SPA 3: Brier/Lurcher

- Fishery Summary
  - Landings in 2003: 225 t (TAC = 200 – 300 t)
  - Landings in 2004: 151 t (TAC = 300 t)
  - Catch rates declined in 2004 relative to high of 2003.
  - Average meat weights >16 g
  - Growth close to average.

- Survey Summary
  - Commercial size Scallops (80+mm) mainly concentrated in SW portion of Lurcher Shoal.
  - Biomass index second highest in series.
  - Little sign of recruitment for 2005.
  - Scallops 10 to 25 mm highest in series and wide-spread.

- Population Model
  - Delay-difference model fit to catches, survey biomass, clappers and growth estimates from survey.
  - Time series too short to give precise results.
  - Evidence of selectivity effects.

- Outlook
  - No reference points for this fishery.
  - Predictive capability of population model not adequate.
  - Based on survey, population stable at 150 to 200 t.
  - 2003 year-class could be strong.

Scallops in SPA 4: Digby

- Fishery Summary
  - Landings in 2003/2004: 945 t (TAC = 1000 t)
  - Landings in 2004/2005: 278 t as of 29/11/2004
  - Interim TAC for 2004/2005 set at 400 t.
  - Catch rates declined in 2003/2004 and 2004/2005 (October).
  - Average meat weights >17 g.
  - Growth seems to have improved.
- Survey
  - Increasing distribution of lobster gear in June necessitated moving surveys to August.
  - Mechanical problems with J.L. Hart resulted in survey conducted in mid-September.
  - Differences in growth, etc., between June and August accounted for.
  - Decline in shell height frequencies and biomass faster than expected for catches.
  - Little signs of recruitment for 2005 and 2006.
  - Clapper index indicates non-fishing mortality low.
  - Did observe "brittle" shells.

- Population Model
  - Delay-difference model fit to catches, survey biomass, clappers and growth estimates from survey.
  - Decision rule for setting TACs set on basis of probability of population biomass decreasing below threshold level.
  - Model forecasts declining in reliability.
  - Analysis of relative selectivity by shell height data from survey suggest that catchability to survey gear has varied over time.
  - New model developed allowing for variable catchability. This improved forecasts but suggest that population biomass substantially less than previously estimated.
  - Given population now estimated to be smaller, decision rule based on maintaining population above threshold no longer applicable. New approach will need to be developed.

- Outlook
  - Population biomass and commercial catch rates are expected to decline over the next two years as there is expected to be below average recruitment over this time period.

Scallops in SPA 5: Annapolis Basin

- Fishery Summary
  - Total landings for 2004 were reported as 20.4 t, the highest reported landings in the 1976 to present period.
  - High catch rates in 2002, 2003 and 2004 reflected the recruitment of the strong 1999 and 2000 year-classes .

- Effort in Annapolis Basin was low in 2002 despite the high catch rate because effort was directed to winter fishery in SPA 4 where the abundant 1998 year-class was present.
- Commercial meat samples: Meat weights remained high during the 2002 and 2003 seasons despite the strong recruitment occurring at the same time. No samples were collected during the 2004 season.

- Research Survey Survey
  - Strong 1999 and 2000 year-classes evident in the shell height frequencies from the annual survey. Currently these year-classes have been fished down and recruits from the 2001 and 2002 year-classes appear to be of very low abundance.
  - Annual trends: The 2004 survey index indicated a decline from the previous two years but is still above the indices observed from 1997 to 2001.
  - Recruitment is expected to be weak for the 2005 and 2006 seasons.

- Outlook
  - At present no models are used to assess the status of this stock.
  - Based on survey estimates, the stock is relatively healthy but there is expected to be little recruitment for the next two seasons.
  - Given the expected lack of recruitment for the next two seasons, the TAC for 2005 should not exceed the average over the low abundance periods of 1997 to 1999 of 10 t.

Scallops in SPA 6

Due to vessel problems there was no survey of SPA 6 in 2004. Without a survey our only basis for advice is catch rates and meat weight sampling.

Landings and effort are continuing to decline in this area, but with the lower effort, catch rates for both fleets remain above average for those who are still fishing.

The meat weight sampling shows the fishery is relying on scallops larger than 11 g, with little evidence of small scallops in the catch. The exception to this is in SPA 6C where there were small scallops landed in March and April.

Catch rates and meat weight sampling indicate little sign of above average recruitment, and a population of mature scallops that is being fished down. The population has been stable with removals of 80 to 160 t per year, and as long as effort remains low catch rates should remain steady in 2005.

On 2 August 2004, the remaining Mid Bay quotas for SPA 1 and SPA 6 were combined and allowed to be taken in any part of the two SPA's that were open. At the same time, fishing in SPA 6 was restricted to 6 am to 6pm Monday to Friday. This resulted in all but 0.5 t of the remaining combined quota being taken in SPA 1.

The quota in SPA 6 was not lowered in recent years as the biomass declined, with the rational that the economics of the fishery will reduce effort. This has appeared to be the case, as effort has declined and landings are less than half of the TAC. The combining of the quotas in 2004 appeared to be a way of increasing the SPA 1 quota in mid year. It was discussed if a recommendation be made to lower the quota in SPA 6 to bring it in line with landings and prevent this from happening in the future. In the end it was decided that this was a management decision, and they could just as easily raise the SPA 1 quota without changing

anything in SPA 6. Science provides their best advice and it is management's decision how the TAC's should be set.

Conclusions:

- Catch rates are steady but effort very low
- Fishery did not catch TAC in 2002 to 2004
- 2003 survey showed population of fully recruited scallops, few pre-recruits

Management considerations for both SPA 1 and 6:

- Fishery has consistently overrun quota in SPA 1B.
- Sharing formula has yet to be defined for SPA 1 quota.
- Still problems with delayed reporting by Mid and Upper Bay fleets

COMMENTS FROM SCIENTIFIC REFEREES

Dr. Ross Claytor

SPA 1: 8-16 mile zone

Fig. 3: Unlined and lined ratios similar to Fig. 12 for SPA 4.

Fig. 5: trends in Hart unlined/ lined ratios differ slightly. Is this an indication of the variation we can expect? Are the trends still related to abundance?

Many of the comments are the same as for SPA 4, concerning the width of confidence limits etc.

SPA 3

Why the difference between catch and TAC.

Make all maps same scale for density. Some years <65 are greater than >80.

What is basis for large recruits entering in 2007.

SPA 4

Fig. 2: Effort seems to have increased before stock build up. Previously, increase in effort was consistent with recruitment pulse. Why, and what are the implications for stock abundance estimates?

No. 3 Growth: What is the interpretation of change in meat weights. What does high meat weight mean?

Survey numbers:

Fig. 4: What is the meaning of the lines?

Fig. 6,7, 8: What are densities, numbers?

Fig. 6.7, 8: comparisons to previous years would be of interest, perhaps a line in text with reference?

Fig. 6.7, 8: What are expectations of pre-recruits compared to legal sizes? When we saw the big year-class was scaling of the map necessary to show recruits?

Fig. 9: Make scale of clappers proportional to fig. 6,7,8 in order to readily calculate mortality qualitatively. Similar in time of major die-off how would the densities compare to those we see now.

Survey Biomass:
Fig. 5: Decline greater than expected, meat weights up.

Population Model:
(a) forecasts compared to observed
Difference between forecast and observed not attributable to growth.

Confidence limits larger now when stock is high compared to earlier years when they were lower.

How different are the differences between forecasts and observed over time?

(c) Survey biomass estimates

No error bars around estimates of lined unlined gear. Can this be done, would it show no difference?

Compare mean ratio to abundance. What is abundance in this case and does it depend on values going into the ratio, what bias might there be because of this?

Plot or analysis is needed of these ratios against abundance, we cannot see that from any figure.

Does the statement in the Hart series the relative efficiency is flat, mean that this is not the problem?

Was it the same commercial gear and boat used in the early part of the time-series.

(d) modeling variable catchability
Fig. 15: same comments as above.

What is the function?

Estimates of F still above targets?

Compare Fig. 19 and Fig. 10, is the new model really better?

7. Decision rules

Every option >0.50 prob of lowering biomass below reference.

Proposal for an exploitation rate threshold

Make table consistent with other table for proper comparison.

What are the sources of uncertainty in the model? Clapper mortality, growth, catchability. Some comment on the relative importance or likelihood of these would be helpful.

SPA 5 RAP

Fig. 1: Effort does not follow abundance as in SPA 4.

Fig. 2: Is there a way to label year-classes on these graphs, it would make them clearer with respect to the text.

Fig. 3 and others like it: What are the units for density?

What is the interpretation for meat < 8g?

General

If we are over-exploiting these populations what would we expect to see in our sampling? Fewer older animals, change in meat weight or counts, etc.

Can we measure any of these, independent or in conjunction with the survey?

The exploitation rate analysis, seems to be a good way to provide practical and long–term advice for this fishery while in a state of low abundance.

Dr. Robert Mohn

SPAs 1,3,4,5,6

Steve Smith and the scallop team are to be complimented for the development of analytical tools for the Bay of Fundy scallop resources.

My focus is mostly on the delay difference population model, its structure, diagnostics and implications. Several smaller points were made to the author at the RAP.

The review was hampered by the lack of working papers, specifically a detailed description of the "revised" model and the background work on selectivity of the survey gear. The selectivity work was critical to the development of the annual q (revised) model. The revised model has quite an effect on the perception of the stock in Area 1 (Fig 7) as all estimates are about halved and in one year (2001) the removals equal the population. The effect on area 4 was more to damp out the spikes. The new model has about 20 more parameters and it is not surprising that it fit the data better, although it is not so obvious why it should be more predictive. One instance of the surprising improvement to predictivity is the case when the annual q was falling (SPA 4), but still using the last year's value placed the forecast right on the subsequent realisation. In other word the wrong q seemed to give the right 80+ biomass. These, and related, technical considerations need a venue for investigation, which may well result in the exporting of this promising approach to other stocks.

Some good preliminary work was also briefly presented on the determination of biological reference points for scallops. It suffered from insufficient review before the RAP, and again the RAP was neither constituted, nor resourced, to provide a critical examination. Some questions unique to stocks such as scallops which oscillate arise; for example, what is the use of concepts

like average recruitment or biomass in the context of Biological Reference Points (BRPs). It would be of considerable value to know what is the controlling factor of the episodic recruitment; especially if scallop biomass is a factor. Once this is known, or can at least be conjectured, an operational model could be developed for testing management strategies.

This RAP, more than most, suffered in that it fell between two stools. There was neither the opportunity for technical review nor a sufficiently reviewed model to stress the management implications. This is to some degree the result of the constraints resulting from the benchmark/update system which is in place.

ADDITIONAL SCIENCE INPUTS

There were two agreed upon requests for input addressed to Stephen Smith. It was agreed that these pieces, which were discussed at the meeting, would be documented in the proceedings. The document provided by Stephen Smith after the meeting is reproduced verbatim. The first section is on "Biological Reference Points for scallops" ; the second one is on "Modifications to scallop population model"

Biological Reference Points for Scallops

There are no explicit definitions of biological reference points with respect to overfishing for sea scallop (*Placopecten magellanicus*) stocks in Canada (Smith and Rago 2004). In the Bay of Fundy, scallop stocks tend to cycle between high biomass and low biomass years with no regular period for the peak years. The relationship between stock and recruitment is complex and appears to be a function of average size of scallops in the population as well as density-dependent habitat suitability factors (Smith and Rago 2004).

A provisional population biomass reference level was set for SPA 1 (8–16 mile Digby) and 4 when the large 1998 year-class was beginning to recruit in 2001 and 2002 (Smith and Lundy 2002, Smith et al. 2003). The goal was to set catches so that the decline in population biomass to this reference level would be slow allowing for this recruitment to sustain the fishery for a number of years. The reference level was set to a $F_{0.1}$ biomass based upon yield-per-recruit analysis of data from non-peak years. The population model used in the assessments uses Bayesian methods to estimate parameters and provide posterior distributions for decision making. The decision rule that had been used in 2002 and 2003 to set catch levels referred to the probability of the population biomass dropping below the reference level for a given catch.

In the 2004 assessment, the population model was corrected to include time-varying catchability coefficients. This change also resulted in the model estimating the population biomass at a much lower level than previous assessments. While this change appeared to interpret the survey data more accurately and better reflect trends in the commercial catch rate, it also meant that the population biomass had declined to non-peak abundance levels faster than had been anticipated. Therefore the decision rule based upon the provisional biomass reference level was no longer applicable as any catch level would have a high probability of the population biomass declining below this reference level.

An alternative approach for evaluating catch levels was presented based upon estimated exploitation rate and the associated change in biomass. For SPA 4 and 1 fishing at rates greater than 0.2 generally results in a decrease in biomass except for those years where large year-classes recruited to the biomass in year t + 1 (Fig. 1 and 2). For those years where exploitation was less than or equal to 0.20, growth and recruitment appears to have

compensated for losses due to fishing and natural mortality. These were also years in which recruitment was low (i.e., non-peak years) as it is expected to be for the next 2 or more years. Decision rules can be developed to evaluate the probability of catch levels resulting in exploitation rates exceeding 0.2 during non-peak years (Tables 1 and 2). This approach is still in the development stage and was not used to make decisions on TACs.

References

Smith, S.J., and M.J. Lundy. 2002. Scallop Production Area 4 in the Bay of Fundy: Stock status and forecast. Can. Sci. Advis. Sec. Res. Doc. 2002/18.

Smith, S.J., and P. Rago. 2004. Biological reference points for sea scallops (*Placopecten magellanicus*): The benefits and costs of being nearly sessile. Canadian Journal of Fisheries and Aquatic Science. 61: 1338–1354.

Smith, S.J., M.J. Lundy, D. Roddick, D. Pezzack, and C. Frail. 2003. Scallop Production Areas in the Bay of Fundy and Scallop Fishing Area 29 in 2002: Stock status and forecast. Can. Sci. Advis. Sec. Res. Doc. 2003/010.

Table 1. Posterior probabilities for the exploitation rate exceeding provisional reference biomass level (Ec = 0.20) for Scallop Production Area 4.

Catch in 2004/2005		**P(E<Ec) Catch in 2005/2006**			
Meats (t)	P (E<Ec)	100	200	300	400
400	0.80	0.31	0.57	0.73	0.83
500	0.90	0.38	0.61	0.76	0.85
600	0.95	0.44	0.66	0.78	0.87

Table 2. Posterior probabilities for the exploitation rate exceeding provisional reference biomass level (Ec = 0.20) for Scallop Production Area 1.

Catch in 2004/2005		**P(E<Ec) Catch in 2005/2006**			
Meats (t)	P (B<Bc)	100	200	300	400
100	0.13	0.26	0.68	0.86	0.94
200	0.70	0.37	0.74	0.88	0.95
300	0.89	0.49	0.79	0.91	0.96

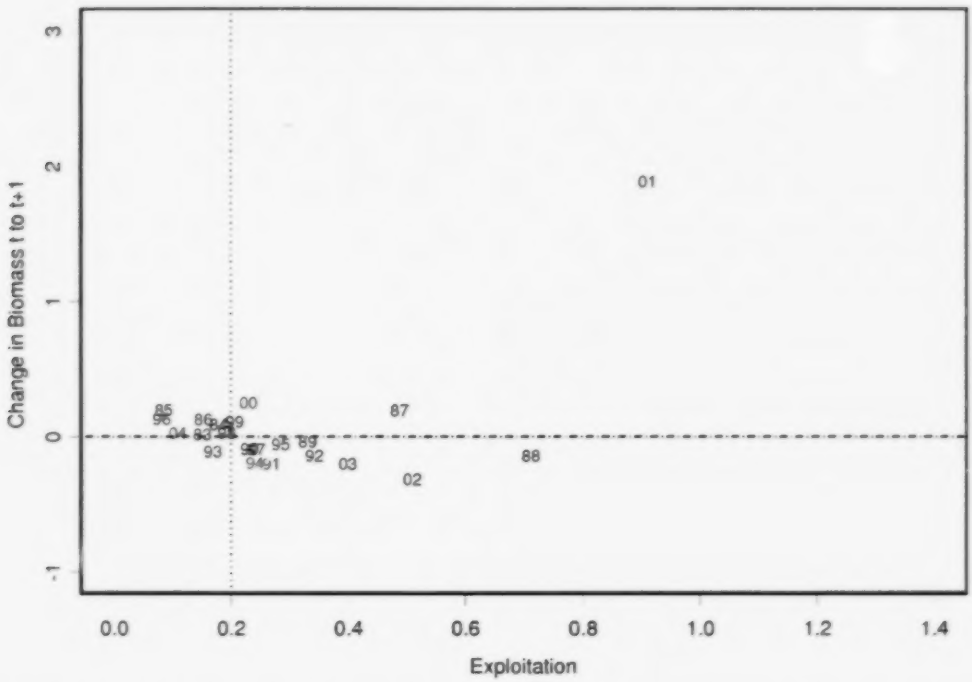

Figure 1. Exploitation rate versus change in population biomass (80+ mm shell height) in scallop production area 1 from year t to year t + 1. Points are labelled as year t.

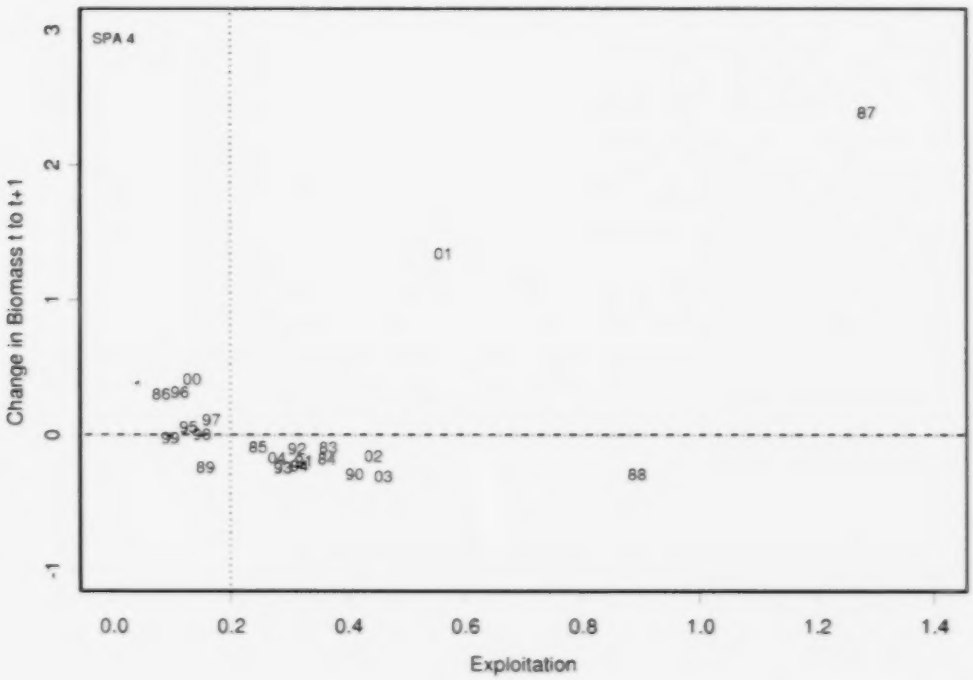

Figure 2. Exploitation rate versus change in population biomass (80+ mm shell height) in scallop production area 4 from year t to year t + 1. Points are labelled as year t.

Modifications to Scallop Population Model

In recent assessments of the scallop stocks in scallop production area (SPA) 1 (8–16 mile off of Digby), 3 and 4, delay-difference models had been used to model population biomass trends over time (Smith and Lundy 2000, Smith and Lundy 2002, Smith et al. 2003). These models use survey biomass estimates to model the trends in the population and estimate population biomass by assuming that there is a proportional relationship between the survey biomass estimate and the population biomass estimate. That is,

$$I_t = q_I \times B_t,$$

where I_t is the survey biomass estimate, q_I is the proportionality constant for I_t, often referred to as the catchability coefficient and B_t is the population biomass. The catchability coefficient which is estimated in the model is assumed to be constant over time, reflecting the fairly standard belief that the survey biomass estimates have a constant relation to the population biomass over time. In the models I_t referred to the biomass of commercial size scallops (shell height ≥ 80 mm) and a separate term R'_t with it's own catchability coefficient q_R was used to represent the recruits.

While these models had fit the survey and catch data quite well over the last few years, their ability to predict next year's biomass for different levels of catch in the upcoming season was steadily declining (E.g., SPA 4 in Fig. 1). This consistent overestimation of population biomass limited the usefulness of these models to advise on future catch levels. At first it was believed that large changes in growth rate over the last five years were behind the differences between observed and predicted but an overestimation of the survey biomass was not consistent with the observed increase in growth and meat weight-at-shell height in 2004.

The survey gear consists of four Digby style drags, two of which are lined with 38 mm polypropylene stretch mesh. Catches in the lined gear were used to estimate the abundance of scallops with shell height less than 80 mm while the catches from the unlined gear were used to estimate the abundance of scallops with shell heights greater than or equal to 80 mm (commercial size scallops). Catches of scallops with shell heights less than 40 mm are thought to give qualitative indications of abundance only, due to uncertainties about the catchability of the small animals. Preliminary investigations of the relative selectivity of scallops by shell height to the two kinds of gear suggested that scallops of shell height 75–80 mm and larger were more likely to be retained by the unlined gear than the lined gear. As long as this tendency was constant over time a model assuming constant q_I and q_R would be appropriate. A rough check on this assumption is to compare the stratified mean number per tow for commercial size scallops separately for the lined and unlined gear (Fig. 2). During periods of low abundance the two kinds of gear have similar estimates while during high abundance periods the unlined gear estimates are much higher than those for the lined gear. Fishermen have reported that their catches are cleaner when abundance is high and while this may be because they do not tow as long, we have noticed the same thing for our survey tows and the length of a survey tow is constant during high and low abundance periods.

For this year's assessment we modified the population model to allow for time-varying catchability coefficients. The q_I coefficients were estimated for each year. However, this resulted in too many parameters to have annual estimates of the q_R and constraints had to be introduced. As a first cut, we constrained the q_R to be equal to the ratio of the lined to unlined estimates of stratified mean number per tow times q_I. This model fit the catch and survey data for SPA 4 as well as or better than the constant catchability coefficient model but estimated a

substantially smaller population size (Fig. 4). This implies that the catch levels set by using the constant catchability model were possibly higher than they should have been if we had hoped to sustain the fishery on the large 1998 year-class for a number of years. Declines in commercial catch rate seem to support this revised view of the population status. This version of the model showed marked improvement in the model predictions (Fig. 5).

These results should be considered preliminary until a full evaluation of the relative selectivity of the survey gear has been completed. While the model results were quite promising for SPA 4 and to a somewhat lesser extent for SPA 1, the model did not substantially improve the situation for the SPA 3.

References

Smith, S.J ,and M.J. Lundy. 2002. Scallop Production Area 3 and Scallop Fishing Area 29: Stock status. Can. Science Advis. Sec. Res. Doc. 2002/17.

Smith, S.J ,and M.J. Lundy. 2002. Scallop Production Area 4 in the Bay of Fundy: Stock status and forecast. Can. Science Advis. Sec. Res. Doc. 2002/18.

Smith, S.J., M.J. Lundy, D. Roddick, D. Pezzack, and C. Frail. 2003. Scallop Production Areas in the Bay of Fundy and Scallop Fishing Area 29 in 2002: Stock status and forecast. Can. Science Advis. Sec. Res. Doc. 2003/010.

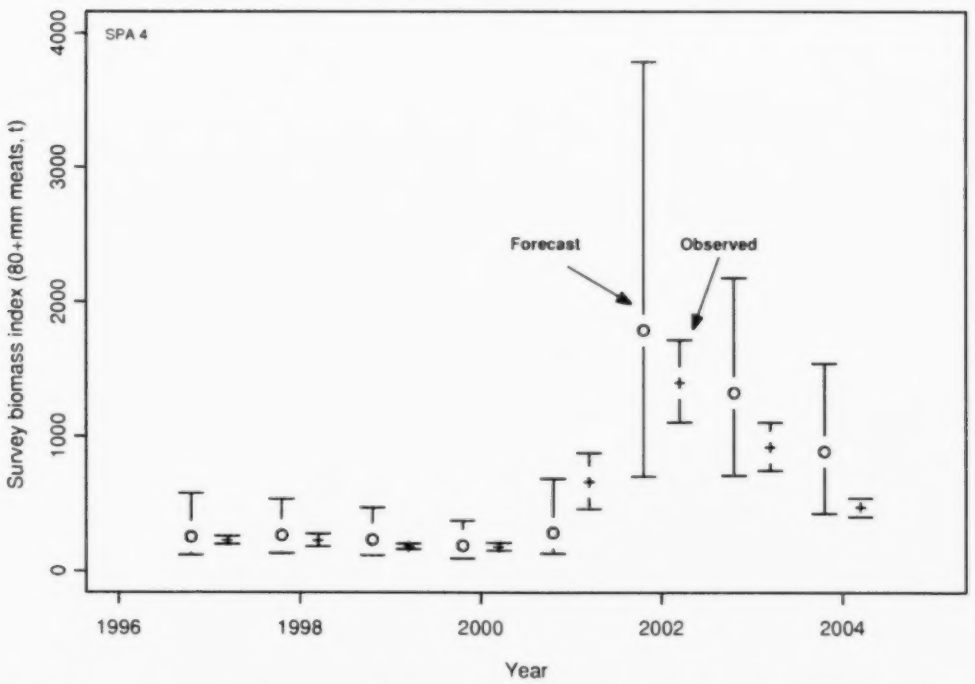

Figure 3. Comparison of predicted survey commercial-size scallop biomass from population model with observed survey biomass in scallop production area 4. These predictions are assuming constant catchability of scallops to the survey gear over time.

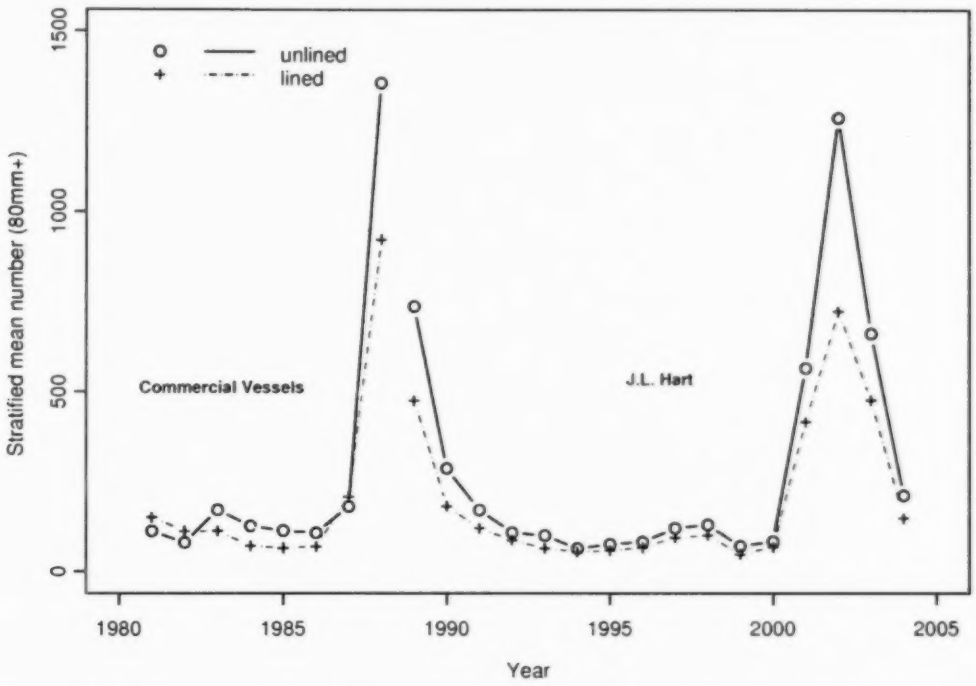

Figure 4. Comparison of stratified mean number estimates for the lined and unlined survey gear. Bay of Fundy scallops, scallop production area 4.

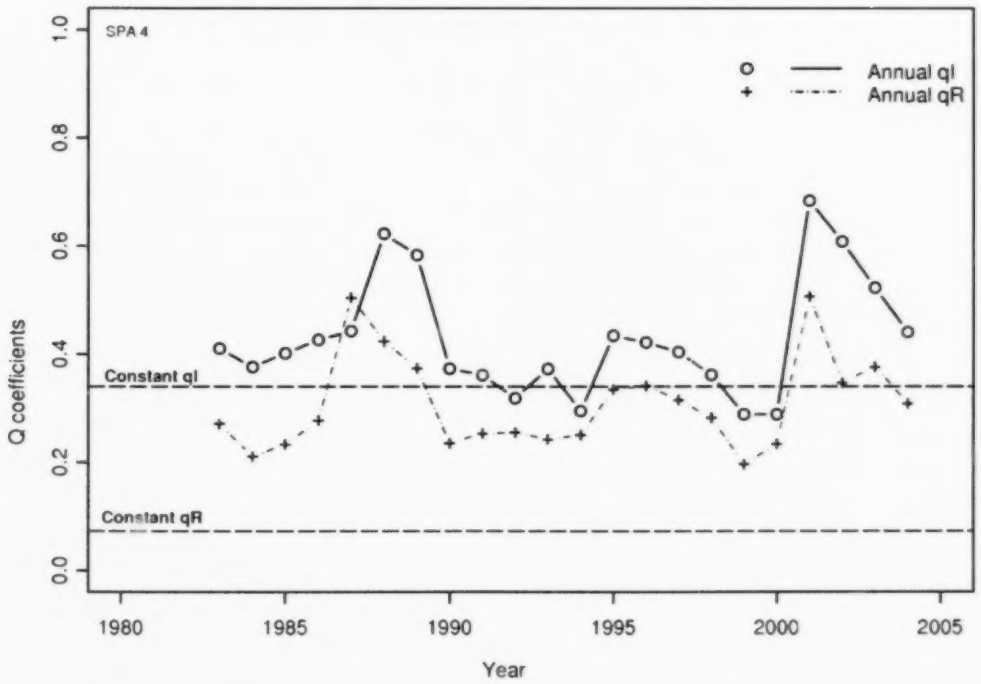

Figure 5. Comparison of annual estimates of the catchability coefficients to estimates based on constant catchability coefficients. Bay of Fundy scallop, scallop production area 4.

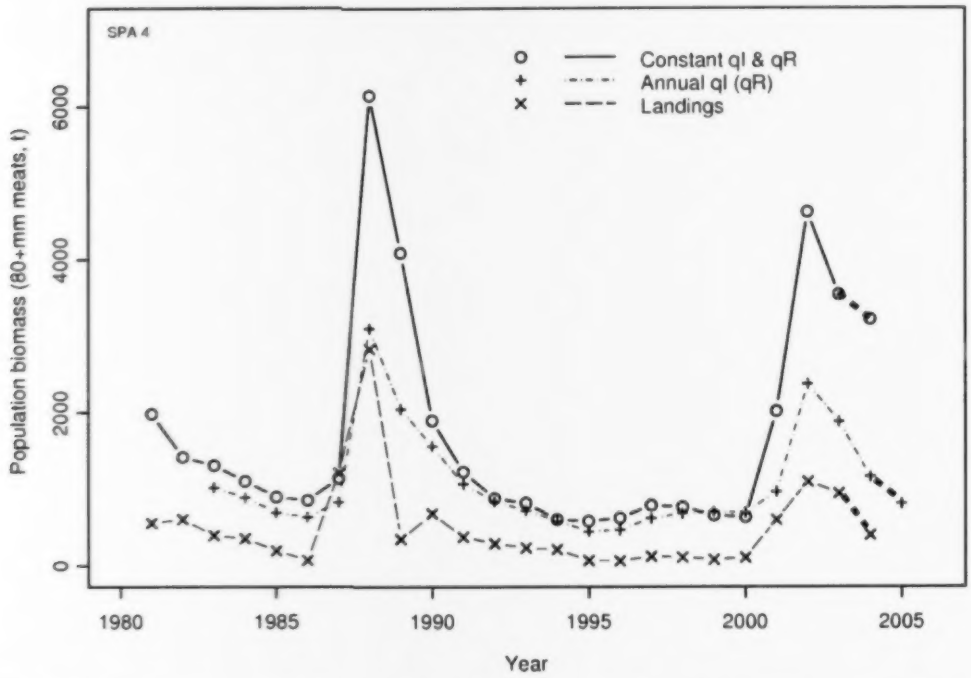

Figure 6. Comparison of scallop population biomass estimates from models assuming constant catchability and variable catchability. Bay of Fundy scallops, scallop production area 4.

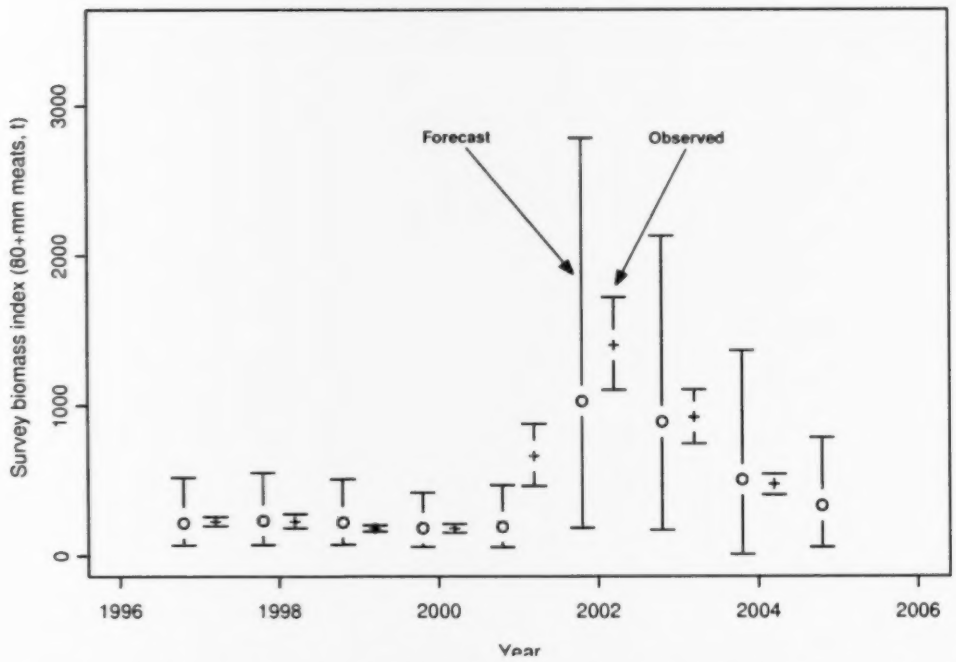

Figure 7. Comparison of predicted survey commercial-size scallop biomass from population model with observed survey biomass in scallop production area 4. These predictions are assuming variable catchability of scallops to the survey gear over time.

Appendix 1. Letter of Invitation

Invertebrate Fisheries Division
Maritimes Region, Science Branch
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
Nova Scotia, B2Y 4A2
(TEL: 902 426-7444)
(FAX: 902 426-1862)

Division des invertébrés
Région des Maritimes, Direction des sciences
Institut océanographique de Bedford
C.P. 1006, Dartmouth
(Nouvelle-Écosse) B2Y 4A2
(TÉL. : 902 426-7444)
(FAX : 902 426-1862)

24 November 2004

Le 24 novembre 2004

Distribution

Liste de diffusion

Subject: Stock Assessment Update of SPA 1, 3, 4, 5, and 6 Scallop Stocks

Objet : Mise à jour des évaluations des stocks de pétoncle des APP 1, 3, 4, 5 et 6

The stock assessment update of the inshore Bay of scallop stocks will be reviewed in the Conference Room of the Mic Mac Amateur Aquatic Club, 192 Prince Albert Road, Dartmouth, Nova Scotia, during 8-9 December 2004, commencing at 9:00 am. The meeting's terms of reference are attached.

La mise à jour des évaluations des stocks de pétoncle des eaux côtières de la baie de Fundy fera l'objet d'un examen dans la salle de conférences du MicMac Amateur Aquatic Club, 192, chemin Prince Albert, Dartmouth, Nouvelle-Écosse les 8 et 9 décembre 2004, à partir de 9 h. Le cadre de référence de la réunion est joint à la présente.

The purpose of the review is to consider the assessments' data inputs, to examine the scientific approaches of the stock assessments, to identify any weaknesses in data and/or methodology, to help improve the clarity of the assessments, and to make recommendations for further research. It will include a detailed examination of the stock assessments and writing of Stock Status Reports.

La réunion aura pour but d'examiner les données d'entrée des évaluations de stock et les approches scientifiques de ces évaluations, de mettre en évidence toute faiblesse dans les données et/ou la méthodologie, d'améliorer la clarté des évaluations et de formuler des recommandations de recherches futures. Elle comprendra un examen détaillé des évaluations de stock et la rédaction des Rapports sur l'état des stocks.

Copies of the assessments and the draft stock status reports will be sent to participants one week before the meeting. At the meeting, DFO science staff will provide a brief overview of the assessments, which will include the main conclusions, the supporting evidence, any new methods, and major limitations. The presentation will be followed by discussion among the participants. The finalised stock status report will be prepared at the meeting. The minutes of this meeting will be published as a proceedings.

Des copies des évaluations et des ébauches de Rapports sur l'état des stocks seront envoyées aux participants une semaine à l'avance. À la réunion, les scientifiques du MPO présenteront un bref aperçu des évaluations, portant sur les principales conclusions, les preuves à l'appui de ces dernières, toute nouvelle méthode et les principales limites. La présentation sera suivie d'une discussion entre les participants. La version définitive des Rapports sur l'état des stocks sera établie à la réunion et le procès-verbal de cette dernière sera publié sous forme de compte rendu.

I would appreciate if you could confirm your attendance with Linda Worth-Benzanson at (902) 426-7444 (WorthBenzansonL@mar.dfo-mpo.gc.ca).

Je sous serais reconnaissant de bien vouloir confirmer votre présence en communiquant avec Linda Worth Benzanson, au (902) 426-7444 (WorthBenzansonL@mar.dfo-mpo.gc.ca).

We greatly appreciate your contribution to this valuable exercise.

Nous vous sommes très reconnaissants de votre contribution à cette importante activité.

Original signed by / Signataire de l'original

René E. Lavoie
Meeting chair /Président de la réunion

Attachment / Pièce jointe

cc : RAP Coordination Committee
L. Worth-Benzanson

Distribution / Diffusion

Appendix 2: List of Invitees

Science / Sciences

Mark Lundy
Dale Roddick
Ginnette Robert
Stephen Smith
Rene Lavoie
Ross Claytor
Robert Mohn
Stratis Gavaris
Jamie Gibson
Chris Jones

Government - Others / Gouvernements – Autres

Maureen Butler, Maritimes
Ron Cronk, NB/N.-B.
Jim Jamieson, Maritimes
Bruce Osborne, NS/N.-É.
Ian Marshall, DFO/MPO, Yarmouth
Gerald Cline, A/Area Manager, SWNB, / Gestionnaire de secteur p.i., S.-O. N.-B., St. Andrews

Industry / Industrie

Keith Amero
Kevin Amireault
Michael Chute
Greg Hamilton
Kevin Hurley
Vance Hazelton
Marc Johnston
Thomas O'Neil
Klaus Sonnenberg
R.G. (Dick) Stewart
Greg Thompson
Glen Wadman
Dick Stewart

Appendix 3. List of participants

PARTICIPANT	ADDRESS	PHONE	FAX	E-MAIL
René Lavoie	DFO @ BIO, Dart, NS	(902)426-2147	(902)426-1843	lavoier@mar.dfo-mpo.gc.ca
Ross Claytor	DFO @BIO, Dart, NS	(902)426-4721	(902)426-1862	claytorr@mar.dfo-mpo.gc.ca
Ginette Robert	DFO @ BIO	(902)426-2616	(902)426-1862	robertg@mar.dfo-mpo.gc.ca
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Bob Mohn	DFO @ BIO	(902)426-4592	(902)426-1506	mohnr@mar.dfo-mpo.gc.ca
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Joy Fry	Full Bay Scallop assoc.	(902)742-9101	(902)742-1287	aherring@ns.aliantzinc.ca
Anne Harrington	DFO, Southwest NB	(506)529-5850	(506)529-5858	harringtona@mar.dfo-mpo.gc.ca
Jim Jamieson	DFO, Marine House	(902)426-8981	(902)426-9683	jamiesonj@mar.dfo-mpo.gc.ca
Marc Johnston	NB DAFA	(506)755-4000	(506)755-4001	marc.johnston@gnb.ca
Maureen Butler	DFO, Marine House, Dart.	(902)426-9856	(902)426-983	butlerm@mar.dfo-mpo.gc.ca
Dale Roddick	DFO @ BIO	(902)426-6643	(902)426-1862	roddickd@mar.dfo-mpo.gc.ca
Vance Hazelton	Full Bay	(902)245-5712	(902)245-2721	vah@ns.sympatico.ca
Manon Cassista	DFO @ BIO	(902)426-2665	(902)426-1862	cassistam@mar.dfo-mpo.gc.ca
Mark Lundy	DFO @ BIO	(902)426-3733	(902)426-1862	lundym@mar.dfo-mpo.gc.ca
Stephen Smith	DFO @ BIO	(902)426-3317	(902)426-1862	smiths@mar.dfo-mpo.gc.ca
Bruce Osborne	NSDAF	(902)424-0352	(902)424-1766	osbornbd@gov.ns.ca
Lance Paul	Membertou First Nation	(902)567-2018	(902)567-0933	lancepaul@membertou.ca

Appendix 4 : Remit of the Meeting

Remit
Meeting of the Maritimes Regional Advisory Process on SPA 1, 3,4, 5 and 6 Scallop Stocks

8-9 December 2004

Mic Mac Amateur Aquatic Club
192 Prince Albert Road
Dartmouth, Nova Scotia

Area 1 Scallop

- Assess the status of Area 1 scallop. The assessment should include:
  - An analysis of available commercial and survey information since 1981
  - Application of the assessment model used CSAS research document 2003/010
- Review advice provided for the 8–16 mile Digby area for Full Bay fleet and provide advice for rest of area for the 2004/2005 fishery.
- Produce a section of the Inshore Scallop Stock Status Report documenting the results of the assessment.

Area 3 Scallop

- Assess the status of Area 3 scallop. The assessment should include:
  - An analysis of available commercial and survey information.
  - Application of the assessment model used in CSAS research document 2003/010
- Provide updated advice for the 2005 fishery.
- Produce a section of the Inshore Scallop Stock Status Report documenting the results of the assessment.

Area 4 Scallop

- Assess the status of Area 4 scallop. The assessment should include:
  - An analysis of available commercial and survey information
  - Application of the assessment model used

Demande de renvoi à la réunion du Processus consultatif régional des provinces Maritimes sur les stocks de pétoncle des APP 1, 3, 4, 5 et 6

Les 8 et 9 décembre 2004

Mic Mac Amateur Aquatic Club
192, chemin Prince Albert
Dartmouth (Nouvelle-Écosse)

Stock de pétoncle de l'aire de production 1

- Évaluer l'état du stock de pétoncle de l'aire de production 1, ce qui devrait comprendre :
  - Une analyse des données de la pêche commerciale et des relevés disponibles depuis 1981.
  - L'application du modèle d'évaluation utilisé dans le document de recherche du SCCS 2003/10.
- Examiner l'avis formulé au sujet de la zone de 8-16 milles de Digby pour la flottille de la totalité de la baie et formuler un avis en ce qui concerne le reste de l'aire de production pour la pêche de 2004-2005
- Produire une section du Rapport sur l'état des stocks de pétoncle des eaux côtières documentant les résultats de l'évaluation.

Stock de pétoncle de l'aire de production 3

- Évaluer l'état du stock de pétoncle de l'aire de production 3, ce qui devrait comprendre :
  - Une analyse des données de la pêche commerciale et des relevés disponibles.
  - L'application du modèle d'évaluation utilisé dans le document de recherche du SCCS 2003/10.
- Formuler un avis actualisé pour la pêche de 2005.
- Produire une section du Rapport sur l'état des stocks de pétoncle des eaux côtières documentant les résultats de l'évaluation.

Stock de pétoncle de l'aire de production 4

- Évaluer l'état du stock de pétoncle de l'aire de production 4, ce qui devrait comprendre :
  - Une analyse des données de la pêche commerciale et des relevés disponibles.
  - L'application du modèle d'évaluation utilisé

in CSAS research document 2003/010

- Review advice provided for the 2004/2005 fishery.
- Produce a section of the Inshore Scallop Stock Status Report documenting the results of the assessment.

Area 5 Scallop

- Assess the status of Area 5 scallop. The assessment should include:
  - An analysis of available commercial and survey information

- Provide advice for the 2005 fishery.
- Produce a section of the Inshore Scallop Stock Status Report documenting the results of the assessment.

Area 6 Scallop

- Assess the status of Area 6 scallop. The assessment should include:
  - An analysis of available commercial and survey information since 1997.

- Provide advice for the 2005 fishery.
- Produce a section of the Inshore Scallop Stock Status Report documenting the results of the assessment.

dans le document de recherche du SCCS 2003/10.

- Examiner l'avis formulé pour la pêche de 2004-2005.
- Produire une section du Rapport sur l'état des stocks de pétoncle des eaux côtières documentant les résultats de l'évaluation.

Stock de pétoncle de l'aire de production 5

- Évaluer l'état du stock de pétoncle de l'aire de production 5, ce qui devrait comprendre :
  - Une analyse des données de la pêche commerciale et des relevés disponibles.

- Formuler un avis pour la pêche de 2005.
- Produire une section du Rapport sur l'état des stocks de pétoncle des eaux côtières documentant les résultats de l'évaluation.

Stock de pétoncle de l'aire de production 6

- Évaluer l'état du stock de pétoncle de l'aire de production 6, ce qui devrait comprendre :
  - Une analyse des données de la pêche commerciale et des relevés disponibles depuis 1997.
- Formuler un avis pour la pêche de 2005.
- Produire une section du Rapport sur l'état des stocks de pétoncle des eaux côtières documentant les résultats de l'évaluation.

Appendix 5: Agenda

PROPOSED TIMETABLE	EMPLOI DU TEMPS PROPOSÉ
Stock Assessment Update of SPA 1, 3, 4, 5, and 6 Scallop Stocks	**Mise à jour de l'évaluation des stocks de pétoncle des APP 1, 3, 4, 5 et 6**
8-9 December 2004	**Les 8 et 9 décembre 2004**
Mic Mac Amateur Aquatic Club 192 Prince Albert Road Dartmouth, NS	**Mic Mac Amateur Aquatic Club 192, chemin Prince Albert Dartmouth (N.-É.)**
Wednesday, 8th December	*Le mercredi 8 décembre*
09:00: Introduction	9 h : Introduction
09:10-10:00: SPA 4	De 9 h 10 à 10 h : APP 4
10:00-10:30: Break	De 10 h à 10 h 30 : Pause
10:30-11:00: SPA 4	De 10 h 30 à 11 h 00 : APP 4
11:00-12:00: SPA 1	De 11 h 00 à 12 h : APP 1
12:00-13:30: Lunch	De 12 h à 13 h 30 : Déjeuner
13:30-14:00: SPA 1	De 13 h 30 à 14 h : APP 1
14:00-15:30: SPA 3	De 14 h à 15 h : APP 3
15:00-15:30: Break	De 15 h à 15 h 30 : Pause
15:30-16:30: SPA 6	De 15 h 30 à 16 h 30 : APP 6
16:30-17:00: SPA 5	De 16 h 30 à 17 h : APP 5
Thursday, 9th December	*Le jeudi 9 décembre*
09:00: Recap	9 h : Récapitulation
09:15 to 10:00: SSR	De 9 h 15 à 10 h : RES
10:00-10:30: Break	De 10 h à 10 h 30 : Pause
10:30-12:00: SSR	De 10 h 30 à 12 h : RES
12:00: End	De 12 h : Fin de la réunion

Appendix 6. Documents Tabled

Four documents were presented:

Smith, S.J., M.J. Lundy, and D. Roddick. Scallops in SPA 1 (8–16 mile): Population model.

Smith, S.J.,and M.J. Lundy. Scallops in SPA 3: Brier/Lurcher.

Smith, S.J., and M.J. Lundy. Scallops in SPA 4: Digby.

Smith, S.J., and M.J. Lundy. SPA 5: Annapolis Basin.

** However, since the object of the meeting was an update instead of a formal RAP, there were no formal Working Documents tabled and CSAS Research Documents will not be produced.